fluid

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1 Flow past a cylinder

Let ρ_0 be the radius of the cylinder, ρ, ξ the polar coordinate system in use. One possible solution of this problem have these potential and streamline functions:

$$\phi(\rho, \xi) = \left(\rho + \frac{\rho_0^2}{\rho}\right) \cos \xi \tag{1}$$

$$\psi(\rho, \xi) = \left(\rho - \frac{\rho_0^2}{\rho}\right) \sin \xi \tag{2}$$

Although these equations are deeply coupled, the radius ρ and the phase ξ can be obtained as a function of the other quantities. For our purposes, we use ψ.

$$\rho(\psi, \xi) = \frac{\psi + \sqrt{\psi^2 + 4\rho_0^2 \sin^2 \xi}}{2 \sin \xi} \tag{3}$$

$$\xi(\psi, \rho) = \arcsin\left(\frac{\rho\, \psi}{\rho^2 - \rho_0^2}\right) \tag{4}$$